



# SHELF LIFE OF AMARANTHUS DUBIUS- A COMPARATIVE ASSESSMENT

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**Abstract :** Greens are the rich source of iron, calcium, potassium and antioxidants which helps to cope up with malnutrition problems especially in childrens and Pregnant womens in developing countries. Poor handling and storage conditions causes more than 30% post-harvest losses in greens. This could be overcome by the proper management. The present study is taken up in this direction, where genus Amaranthus, considered as a super crop is taken up for post harvest assessment of morphological, physiological and biochemical properties under modified storage at low temperature. The leafy vegetable was kept in active bags and stored in low temperatures at 18<sup>o</sup> C and relative humidity of 75%. The leaf samples were taken at 1-day interval for assessment. The biochemical parameters showed 40% decrease after 5 days and 14% decrease after three days. Among the different biochemical parameters carotenoid showed highest loss percentage. From the present study it can be concluded that preserving the Amaranthus in active bags in low temperature will minimise the post harvest loss and extend the shelf life by preserving the maximum amount of nutrients which helps to overcome the malnutrition problems

**IndexTerms – Amaranthus, Chlorophyll, Carotenoids, Leaf area, Shoot length, Post harvest**

## INTRODUCTION

Amaranthus is a C4 plant tolerant to drought, and plant diseases. Amaranthus, commonly known as amaranth, is a versatile genus of plants valued for its nutritional, agricultural, and ornamental uses. The tender stems and leaves of amaranth are a good source of protein, vitamins, and dietary fiber and serves as an alternative source of nutrition for people in developing countries.

It has a global presence in tropical and subtropical regions like India, China, United states etc. In the current research, *Amaranthus dubius*(Red variety) a commonly grown leafy vegetable, cultivated on a large scale for its economic viability, nutritional benefits and adaptability to various agricultural conditions is taken up for the study. Hertog et al, 1999 reported high quality proteins, carbohydrates and antioxidants in *A. dubius*, which can be used to prevent cancer, diabetes and arteriosclerosis. The vegetables are also rich sources of vitamins like A,C, K, folate and minerals like potassium, phosphorous, calcium and magnesium (Akindahunsi and Salawu,2005;Orech et al,2005 ). Amaranthus is a highly perishable vegetable having a very short shelf life after harvesting which is limiting its productivity, marketing and consumption. In the present study, the morphological, physiological and biochemical assessment of *Amaranthus dubius* is done during post harvest storage to know about nutritious quality of the vegetable.

## NEED OF THE STUDY

Globally the Post-harvest losses of leafy vegetables are estimated to be over 30% caused mainly by storage conditions. Poor populations in developing countries are mainly dependent on these greens since they are cheap and rich source of Vitamins, Antioxidants and Carbohydrates. Amaranthus one of the important staple diet in developing countries is taken up for present work since they have very short shelf life after harvesting, which put constraint on production and marketing.

## RESEARCH METHODOLOGY

The red variety of *Amaranthus dubius* was collected from April 2024 to May 2024 in early morning hours. The collected plant samples were kept inside the iceless cooler and analyzed for morphological, biochemical and physiological, and anatomical parameters. Each analysis was carried out in three trials lasting five days each. Samples were freshly collected for each trial. The samples were taken at 1-day interval for determining the morphological and biochemical parameters.

### Morphological Parameters:

Morphological parameters like shoot length, root length and leaf area were assessed by taking ten randomly selected plants each day for five days in all three trials. These evaluation indicates the growth, stress, nutritional content and photosynthetic capacity of the plants.

Collected plants were thoroughly washed to remove soil debris. For fresh weight, plants were completely removed of any free surface moisture and weighed using electronic weighing machine. Dry weight was measured by drying the plants overnight in a low-heat oven (100° F). Shoot and Root length were measured using method of Gomez and Gomez (1984). For Leaf area, leaves were collected from different parts of the plants and measured using Grid Counting Method (Montgomery 1911).

### Biochemical Parameters:

For sample preparation 1 gm deveined leaves were taken for analysis of carbohydrates, chlorophyll a, chlorophyll b, total chlorophyll and total carotenoid.

Arnon's method (1949) was followed for evaluating the chlorophyll a, chlorophyll b, total chlorophyll and total carotenoid content. Anthrone method was used for estimating the Carbohydrates (Dische,1937). The physiological parameter like relative water content was assessed according to the method given by Jones H.G, (2007).

## RESULTS AND DISCUSSION

The growth, Physiology, stress response and overall health of the plant is critical for enhancing nutrition and shelf life which can be assessed by its biochemical and morphological parameters. The analysis was conducted for 5 consecutive days in three trials. Celine et al (2011) evaluated *Amarathus dubius* in humid tropics of Kerala.

The analysis of different morphological and biochemical parameters of the red variety of *Amaranthus dubius* was conducted for 5 consecutive days in three trials, the results disclose continuous depletion in nutrients with increase in time duration.

The first trial showed continuous decrease in plant weight from first day to last day with least ie 17.09 gm was found on 5<sup>th</sup> day (Table 1). The percentage decrease from first to last day was about 20%. Poorter and Nagel (2000) made similar observation where they correlated plant weight with morphological traits like leaf area, stem diameter and root length. The root length showed 10% decrease on the last day. But the shoot length showed 17% decrease. The leaf area showed similar behaviour with highest 1921.9 mm<sup>2</sup> was noticed on the first day and decreased subsequently with lowest on last day ( Fig 3). According to Percy et al., 1989 the decrease indicates water stress in the plants due to change in temperature and humidity condition.

In the second trial, the plant weight was 20.7 g on the first day, which decreased to 17.9 g on the last day. Similar pattern was observed in root length with highest on the first day and decreased subsequently. The shoot length was 20.73 cm on the first day, this decreased to 19.7cm, 18.74 cm and 18.01 cm on the subsequent days(Fig 1). Gutschickand Wiegel, 1988 attributed the decrease in shoot length to signal stress conditions like nutrient deficiency or environmental change. The leaf area was 1928.4 mm<sup>2</sup> on the first day, this decreased to 1382.6 mm<sup>2</sup> on the Fifth Day.

In the third trial, the plant weight was 20.54g on the first day and 16.8 g on the last day. The root length showed similar pattern with highest on the first day and lowest on 5<sup>th</sup> day(Fig 2). Gaurav et al., 2015, observed temperature fluctuations as the reason for this decrease. The shoot length was 20.54 cm on the first day, this decreased subsequently showing 18.12 cm on the last day. The leaf area was 1943.7 mm<sup>2</sup> on the first day, this decreased to 1854.1 mm<sup>2</sup>, 1647.3 mm<sup>2</sup>, 1465.2mm<sup>2</sup> and 1343.4 mm<sup>2</sup> on the subsequent days. Vijayakumar, (1980); Varalakshmi, (2004); Shukla et al., (2010) reported remarkable variability for biometric characters in vegetable *Amaranthus*

The decrease in the measure of morphological parameters such as plant weight, root and shoot length and leaf area of stored *Amaranthus dubius* is primarily due to lack of photosynthesis due to absence of light leading to nutrient depletion, water loss and senescence (Malini et al 2024).

Physiological parameter: The relative water content of red variety was 85.69%, this indicated that red variety of *Amaranthus dubius* is more drought tolerant. Amma and Rajalakshmi (2023) reported reduction in yield during water stress conditions reflected in terms of relative water content. In conclusion, in our experiment, severe water stress induced different growth responses in *Amaranthus*, which indicates that water stress reduces the yield, so strategies must be taken into consideration for growing any *Amaranthus* variety

Biochemical Parameters: Biochemically, the red variety contains anthocyanins, which have antioxidant and anti-cancer properties. In the current research red variety was assessed for various biochemical parameters which showed nutrient depletion with increase in number of days due to lack of light, temperature and water loss during storage. Steckel et al (2007) carried the work on temperature effect on germination of nine *Amaranthus* spp.

On the first day, in the trial one 8.73µg chlorophyll a was observed which decreased to 6.58 µg/ml on the last day. Similarly Chlorophyll b was 19.78µg/ml on the first day, it decreased to 15.31 µg/ml on the 5<sup>th</sup> day. The total chlorophyll showed similar pattern of decrease from first to last day. Total carotenoids was 10.86 µg/ml on the first day, which decreased to 10.57 µg/ml, 9.88 µg/ml, 9.44 µg/ml and 7.50 µg/ml on the subsequent days. The carbohydrates showed drastic decrease from 640µg/ml on the first day to 340 µg/ml on the fifth day(Table 3).

Trial two showed similar decreasing pattern with the highest amount of chlorophyll on the first day and lowest on the fifth day. The total carotenoids was highest initially, but showed almost 67% decrease on the fifth day. The carbohydrates decreased by 58 % from first to last day

In trial three, Chlorophyll a was 8.71µg/ml on the first day, decreased to 6.21µg/ml on the fifth day. Amount of Chlorophyll b was 23.08µg/ml on the first day, decreased to 17.09µg/ml, 13.98µg/ml, 15.13µg/ml and 14.3 µg/ml on the subsequent days. Total chlorophyll showed similar pattern of decrease from 31.77 µg/ml to 20.56 µg/ml. Amount of total carotenoids was 9.20 µg/ml on the first day, which decreased to 3.77µg/ml on the fifth day (Table 3).

The first, second and third trial revealed 33%, 57% and 35% respective decrease in total chlorophyll (Table 2). Carotenoid showed 31% decrease in the first trial, 34 % in second trial and 60 % decrease in the third trial. Carbohydrates showed 47.1%, 32 % and 47 % decrease (Table 3). The decrease in the amount of carbohydrates in stored *Amaranthus dubius* is primarily due to several metabolic factors, such as respiration, senescence, lack of photosynthesis and enzyme activity. Amalgamation of all the three trials, revealed 35% decrease in total chlorophyll on 5th day and 12% decrease on 3<sup>rd</sup> day. Gross (1991) in his studies on *Amaranthus dubius* made similar observations. Lichtenthaler (1987) evaluated the role of chlorophyll in photosynthetic efficiency of *Amaranthus dubius*. Carotenoid, a precursor of vitamins showed 44 % decrease after 5 days and 15% decrease after 3 days. Similar decrease in vitamin C was observed during the storage of *Amaranthus* by Nyaura et al (2014). The carbohydrate content showed 42% decrease after 5 days and 15% decrease after 3 days. Among the biochemical parameters carotenoid showed highest percentage of decrease. Imungi and Potter, 1983; Belitz, 1987 have also reported drastic decrease in vitamin C and beta-carotene during storage of leafy vegetables.

## CONCLUSION

Globally leafy greens form the important component of healthy diet. The red variety of *Amaranthus dubius*, one of the versatile crop grown in Bangalore, India is highly nutritional and rich source of vitamins, Antioxidants and Minerals. The nutrient content and the price value of this crop makes it very good substitute for other vegetables for urban poor. In the present study, the reduction in the measure of morphological parameters such as plant weight, root and shoot length and leaf area of stored *Amaranthus dubius* is primarily due to lack of photosynthesis due to absence of light leading to nutrient depletion, water loss and senescence. The decrease in the amount of chlorophyll, carotenoids and carbohydrates in stored *Amaranthus dubius* can be primarily attributed to several metabolic factors like respiration, senescence, lack of photosynthesis and enzyme activity, pH changes and temperature variation.

In the current research it is observed that post harvest stability of *A. dubius* can be achieved by storing them in refrigerators or iceless coolers up to five days, but their nutrient efficiency is the best within the first three days. Similar observation was made by Nyaura et al 2014 with respect to ascorbic acid and beta carotene. This contributes to a more sustainable, nutritious, and convenient diet. These factors help to address the malnutrition concern in a cheap and effective way in a developing country like India.

The shelf life analysis of this crop gives the clear picture regarding the nutrient depletion over a period of storage. By further investigation and more such similar studies an alternate storage method can be used to avoid the nutrient depletion.

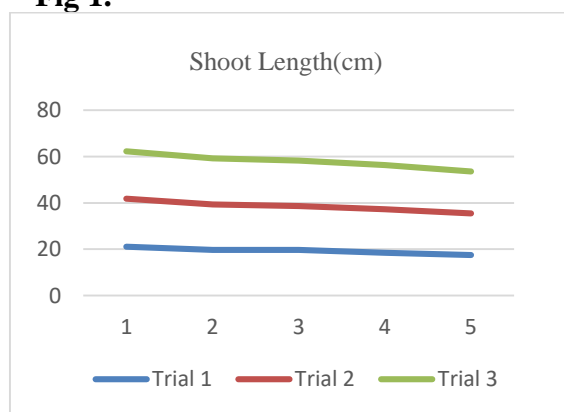
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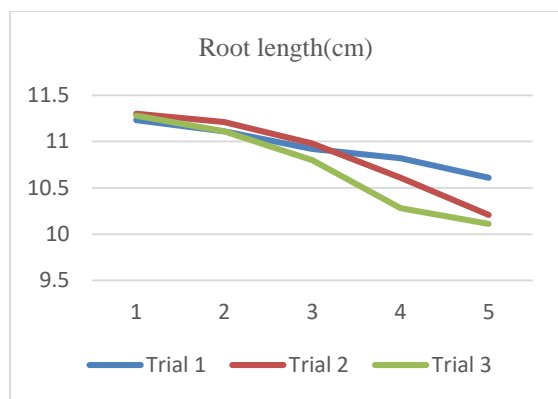
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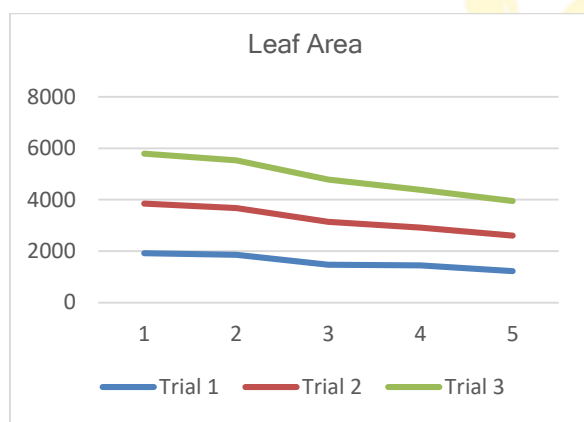
**Fig 1.****Day wise variation in shoot length over three trials**

**Fig 2.**



**Day wise variation in Root length over three trials**

**Fig 3**



**Day wise variation in Leaf Area over three trials**

**Tables:**

**Table 1. Day wise variation in Plant weight over three trials**

Days	Plant weight (gms)		
	Trial 1	Trial 2	Trial 3
1	20.42	20.74	20.54
2	20.29	20.22	19.10
3	19.19	19.22	19.06
4	18.06	18.21	18.00
5	17.05	17.19	16.80

**Table 2. Day wise variation in Chlorophyll over three trials**

Days	Chl a (µg/ml)			Chl b (µg/ml)			T. Chl (µg/ml)		
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
Day 1	8.73	9.82	8.71	21.07	20.73	20.54	1921.9	1928.4	1943.7
Day 2	7.05	9.59	7.71	19.67	19.7	19.87	1860.3	1820.7	1854.1
Day 3	6.93	9.45	7.83	19.66	19.06	19.55	1477.1	1661.9	1647.3
Day 4	6.65	5.25	6.48	18.51	18.74	19.07	1449.1	1467.1	1465.2
Day 5	6.58	4.83	6.21	17.45	18.01	18.12	1227.4	1382.6	1343.4

**Table 3 Day wise variation in Carotenoides and Carbohydrates over three trials**

Days	Carotenoides ( $\mu\text{g/ml}$ )			Carbohydrates ( $\mu\text{g/ml}$ )		
	Trial 1	Trial 2	Trial 3	Trial 1	Trial 2	Trial 3
Day 1	10.86	9.54	9.20	640	620	600
Day 2	10.57	8.97	7.48	580	560	560
Day 3	9.88	8.16	7.05	480	440	500
Day 4	9.44	9.54	5.81	400	400	460
Day 5	7.50	6.36	3.77	340	360	380

